PBEEEP
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Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
Vermilion Community College

Date: 6/6/2012

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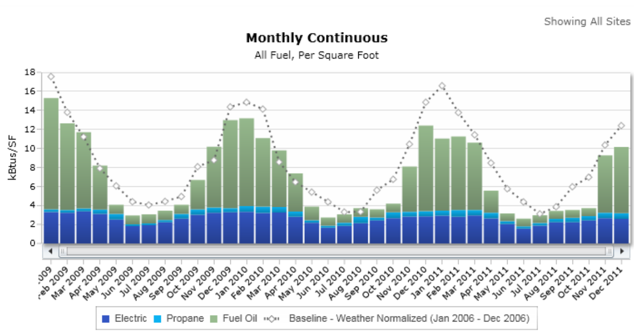
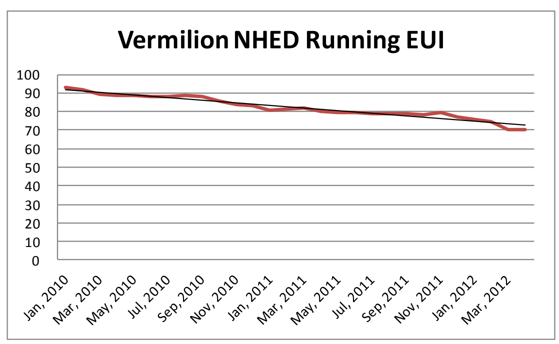
Vermilion Community College Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Vermilion Community College was performed by Karges Faulconbridge, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$38,026		Total Project Cost	$250,346 (or $87,346)
Future costs including Implementation , Measurement & Verification	$212,320 (or $49,320)		Study and Administrative Cost Paid with ARRA Funds	($41,026)
Total Project Cost	$250,346 (or $87,346)		Utility Co-funding	$0
			Total costs after co-funding	$209,320 (or $49,320)
Estimated Annual Total Savings ($)	$32,426 (or $25,116)		Estimated Annual Total Savings ($)	$32,426 (or $25,116)
Total Project Payback	7.7 (or 3.5)		Total Project Payback with co-funding	6.5 (or 2.0)
Electric Energy Savings	**3.2.%**	**and**	**Fuel Oil Savings 15.8%**	**(or 11.6%)**





Vermilion Community College Consumption Report
Total energy use decreased 10% during the period of the investigation

STATE OF MINNESOTA B3 BENCHMARKING

Summary Tables

Vermillion Community College	
Location	1900 E Camp St Ely, MN 55731
Facility Manager	Dave Marshall, Physical Plant Supervisor
Interior Square Footage	180,376; 122,224 included in investigation
PBEEEP Provider	Karges Faulconbridge, Inc.
Project Manager	Keith Harvey, Director of Finance and Facilities
Annual Energy Cost	$326,509 (2011) Source: B3
Utility Company	Range Cooperatives (Propane) Ely Water & Light(Electricity) Various (Fuel Oil)
Site Energy Use Index (EUI)	81 kBtu/ft^2 (at start of study) 72 kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	111 kBtu/ft^2

Building Name	**State ID**	**Square Footage**	**Year Built**
Activities "A" Bldg	E26147C0171	22,690	1971
Administration/College Services	E26147C0271	20,578	1971
Classroom "D" Bldg	E26147C0371	17,886	1971
College Center "C" Bldg	E26147C0785	16,608	1985
Link Bldg/Cafeteria Expansion/Boiler	E26147C1199	13,286	1999
Museum/Interpretive Center	E26147C0580	1,536	1980
Natural Science Building	E26147C0893	9,832	1993
Physical Ed/Enrollment Wing	E26147C1285	2,500	1985
Theater/Fine Arts	E26147C0480	15,697	1980
Wood Boiler Plant	E26147C0685	1,611	1985

Mechanical Equipment Summary Table (of buildings included in the investigation)	
Quantity	**Equipment Description**
1	Automation Systems (Honeywell EBI)
10	Buildings
122,224	Interior Square Feet
10	Air Handlers
55	VAV Boxes
3	Boilers
29	Hot Water Pumps
3	Heat Exchangers
29	Exhaust Fans
18	Unit Heaters (All types)
580	Approximate number of points for trending
219	Min Trend points
15	Loggers for Natural Sciences HVAC (excludes lighting loggers)

Implementation Information			
Estimated Annual Total Savings ($)			$32,426 (or $25,116)
Total Estimated Implementation Cost ($)			$209,320 (or $49,320)
GHG Avoided in U.S Tons (CO2e)			139 (or 113)
Electric Energy Savings (kWh) 3.2 % Savings 2011 Electric Usage 1,524,710 kWh (from B3)			48,694
Electric Demand Savings (Peak kW)			0
Fuel Oil Savings (gallons) 15.8 % Savings 2011 Usage 55,400 gallons from B3 (or 11.6%)			8,749 (or 6,437)
Statistics			
Number of Measures identified			5
Number of Measures with payback < 3 years			3
Screening Start Date	2/22/2011	Screening End Date	8/29/2011
Investigation Start Date	11/3/2011	Investigation End Date	3/02/2012
Final Report	6/6/2012		

Vermilion Community College Cost Information		
Phase	**To date**	**Estimated**
Screening	$3,726	
Investigation [Provider]	$31,485	
Investigation [CEE]	$2,815	$1,000
Implementation		$209,320 (or $49,320)
Implementation [CEE]		$1000
Measurement & Verification	0	$1000
Total	$38,026	$212,320 (or $52,320)

Co-funding Summary	
Study and Administrative Cost	$41,026
Utility Co-Funding - Estimated Total ($)	$
Total Co-funding ($)	$41,026

Facility Overview

The energy investigation identified 9.9% of total energy savings at Vermilion Community College with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Vermilion Community College are based on replacing the boiler with a condensing boiler, adjusting the schedule of equipment to match actual building occupancy hours, correcting the operation of an air handler that currently brings an excessive amount of outside air, and insulating a long section of hot water pipe in the boiler room. The total cost of implementing all the measures is $209,320.
As an alternative, instead of replacing the entire boiler with a higher efficiency condensing boiler, the burner on the existing boiler could be replaced at a lower cost ($40,000 instead of $200,000) which would also reduce the total savings to 8% (instead of 9.9%).

Implementing all these measures can save the facility approximately $32,426 a year with a combined payback period of 6.5 years based on the implementation cost only (excluding study and administrative costs). These measures will produce 3.2 % electrical savings and 13.9 % fuel oil savings. If the less expensive burner replacement is chosen, the savings are $25,116 a year with a 2.0 year payback. The building is currently performing at 35% below the Minnesota Benchmarking and Beyond database (B3) benchmark; energy usage during the period of the study declined by about 10%.

The primary energy intensive systems at Vermilion Community College are described here:

Vermilion Community College includes 14 buildings with a total of 180,376 square feet (sq ft) located in Ely, MN. Most buildings are college classrooms. Ten buildings containing 122,224 will be included in the investigation.

Mechanical Equipment

Heating Plant

The heat at Vermillion comes from two fuel oil boilers and one wood burning boiler (it has not been used lately because of the cost of wood and gas). The hot water is pumped around the campus using three variable speed 3hp, 85 GPM pumps to all buildings on campus.

Cooling Plant

About three quarters of the campus is cooled, but all cooling is done by unitary DX systems. There is no central cooling plant.

Buildings

Most buildings are conditioned by AHUs with DX cooling and hot water heat. There is a fairly even split between constant volume and variable volume AHUs. All VAV boxes have reheat coils and DDC controls.

Controls and Trending

The entire campus is using a Honeywell EBI building automation system. The Honeywell computer is located in the Maintenance Building and can accept USB flash drives for data extractions. The Honeywell system can trend up to 2,000 points and does it very well.

Lighting

Indoor lighting- Interior lighting primarily consists of T8, T5, and LED, therefore a lighting retrofit will not need to be investigated. Most classroom lights are operated by a manual switches.

Outdoor lighting- The outdoor lighting consists of parking lot lighting, side walk lights and some decorative lighting. Some of the lighting is on the BAS and is operated using schedules and daylight sensors.

Findings Summary

Site: NHED Vermilion Ely

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Vermilion Community College	Excessive Enabling	$1,000	$6,521	0.15	$0	0.15	48
6	Vermilion Community College	OA Reduction	$1,000	$2,120	0.47	$0	0.47	7
7	Vermilion Community College	DAT Reset	$5,000	$6,470	0.77	$0	0.77	23
1	Vermilion Community College	Insulation of copper piping	$2,320	$1,781	1.30	$0	1.30	6
4	Vermilion Community College	Boiler Burner Upgrade. This is an alternate to Finding 3.	$40,000	$8,224	4.86	$0	4.86	29
3	Vermilion Community College	New Condensing Boiler	$200,000	$15,534	12.88	$0	12.88	54
		Total for Findings with Payback 3 years or less:	**$9,320**	**$16,892**	**0.55**	**$0**	**0.55**	**84**
		Total for all Findings:	**$249,320**	**$40,649**	**6.13**	**$0**	**6.13**	**167**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

16100 - Ely/Vermilion

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	YES - See Calcs	Trends		
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Not Relevant	See above
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Not Relevant	N/A
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Not Relevant	Cooling not part of scope of work.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	Yes - See Calcs	Trends		
	b.3 (7)	OTHER_Economizer/OA Loads			Not Relevant	N/A
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	Yes - See Calcs	Trends		
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	Yes - See Calcs	Trends		
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls			Not Relevant	N/A
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	New lighting systems
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not cost-effective to investigate	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	Rebalancing is not part of scope of work.
	d.6 (17)	Other_Controls (Setpoint Changes)			Not Relevant	N/A
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	Cooling not part of scope of work.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	Yes - See Calcs	Trends		
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Not cost-effective to investigate	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	Cooling not part of scope of work.
	e.6 (22)	Other_Controls (Reset Schedules)			Not Relevant	N/A
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	Newer lighting systems installed.
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Not Relevant	N/A
	g.1 (28)	VFD Retrofit - Fans			Not Relevant	Fans have VFDs

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Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	Pumps have VFDs
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	No process eqmt
	g.4 (31)	OTHER_VFD			Not Relevant	N/A
h. Retrofits:	h.1 (32)	Retrofit - Motors			Not cost-effective to investigate	
	h.2 (33)	Retrofit - Chillers			Not Relevant	Cooling not part of scope of work.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	Cooling not part of scope of work.
	h.4 (35)	Retrofit - Boilers	Yes- see calcs.			Burner Replacement & boiler replacement with condensing boilers
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not cost-effective to investigate	Equipment was newer, inspections did not uncover major equipment failures
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	Equipment was newer, inspections did not uncover major equipment failures
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	Equipment was newer, inspections did not uncover major equipment failures
	h.8 (39)	Retrofit - Pumping distribution method			Investigation looked for, but did not find this issue.	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not cost-effective to investigate	Equipment was newer, inspections did not uncover major equipment failures
	h.10 (41)	Retrofit - System (custom)			Not cost-effective to investigate	Equipment was newer, inspections did not uncover major equipment failures
	h.11 (42)	Retrofit - Efficient Lighting			Not cost-effective to investigate	Equipment was newer, inspections did not uncover major equipment failures
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	Equipment was newer, inspections did not uncover major equipment failures
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	Equipment was newer, inspections did not uncover major equipment failures
	h.14 (45)	OTHER_Retrofit			Not Relevant	N/A
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	Yes - separate maintenance list. No ECOs calculated because they are small.	Inspections		
	i.2 (47)	Impurity/Contamination			Not Relevant	N/A
	i.3 ( )	Leaky/Stuck Damper	Yes - See Calcs	Trends		
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance			Not Relevant	N/A
j. OTHER	j.1 (49)	OTHER			Not Relevant	N/A

Findings Glossary: Examples of Common Findings Details (Reference)

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**	
		• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**	
		• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**	
		• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**	
		• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**	
		• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**	
		• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**	
		• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**	
		• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**	
		• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**	
		• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**	
		• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**	
		• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**	
		• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**	
		• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**	
		• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**	
		• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**	
		• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**	
		• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**	
		• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**	
		• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**	
		• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**	
		• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**	
		• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**	
		• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**	
		• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**	
		• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**	
		• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**	
		• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**	
		• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**	
		• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**	
		• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**	
		• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**	
		• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**	
		• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**	
		• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**	
		• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**	
		• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**	
		• Please contact PBEEEP Project Engineer for approval

Findings Summary

Building: Vermilion Community College
Site: NHED Vermilion Ely

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Excessive Enabling	$1,000	$6,521	0.15	$0	0.15	48
6	OA Reduction	$1,000	$2,120	0.47	$0	0.47	7
7	DAT Reset	$5,000	$6,470	0.77	$0	0.77	23
1	Insulation of copper piping	$2,320	$1,781	1.30	$0	1.30	6
4	Boiler Burner Upgrade. This is an alternate to Finding 3.	$40,000	$8,224	4.86	$0	4.86	29
3	New Condensing Boiler	$200,000	$15,534	12.88	$0	12.88	54
	Total for Findings with Payback 3 years or less:	**$9,320**	**$16,892**	**0.55**	**$0**	**0.55**	**84**
	Total for all Findings:	**$249,320**	**$40,649**	**6.13**	**$0**	**6.13**	**167**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Vermilion Community College

FWB Number:	16100	Eco Number:	1
Site:	NHED Vermilion Ely	Date/Time Created:	5/31/2012

Investigation Finding:	Insulation of copper piping	Date Identified:	3/1/2012
Description of Finding:	There is an 18ft stretch of 1 1/2" copper HW piping that is uninsulated. This is causing heat loss through that stretch of piping.		
Equipment or System(s):	Other	Finding Category:	Maintenance Related Problems
Finding Type:	Deferred Maintenance from Recommended/Standard		

Implementer:	Owner	Benefits:	Reduce unecessary heat loss/gain at piping
Baseline Documentation Method:	Recorded missing insulation of piping.		
Measure:	Insulate Piping		
Recommendation for Implementation:	Insulate the piping.		
Evidence of Implementation Method:	Verify insulation has been installed		

Annual Fuel Oil Savings (Gallons):	564	Contractor Cost ($):	$2,320
Estimated Annual Fuel Oil Savings ($):	$1,781	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$2,320

Estimated Annual Total Savings ($):	$1,781	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.30	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.30	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	6	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.4%	Percent of Implementation Costs:	0.9%

Findings Details

Building: Vermilion Community College

FWB Number:	16100	Eco Number:	2
Site:	NHED Vermilion Ely	Date/Time Created:	5/31/2012

Investigation Finding:	Excessive Enabling	Date Identified:	3/1/2012
Description of Finding:	Cafeteria AHU, link addition AHU, AHU-S1(library), EF-20, Taxidermy FCU, RTU (natural sciences), AHU-2 (Admin Office-Cafmech RM), AHU-1 (GYM),AHU-2(locker RM) Locker Rm EF (gym AHU-2), EF-1, EF-2, EF-4, EF-21, AHU-1 (Theature), AHU-2 (Museum), AHU-3 (Classroom unit),and Chem Store Rm EF: found excessive operation via trend logs when building is not occupied.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	In-house Staff, Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Trended SF & RF fan status & fan speed for existing schedule and compare to printed schedules. Trended VFD amp draw.		
Measure:	Revise BAS schedule to match building operation schedule.		
Recommendation for Implementation:	Cafeteria AHU, link addition AHU, AHU-S1(library), EF-20, Taxidermy FCU, RTU (natural sciences), AHU-2 (Admin Offices-Cafmech RM), AHU-1(GYM), AHU-2(Locker RM) Locker Rm EF (gym AHU-2), EF-1, EF-2, EF-4, EF-21, and Chem Store Rm EF: Revise BAS schedule to match building operating schedule. Refer to supporting documenation spreadsheet-Calculations- ELY CALCULATIONS-1.		
Evidence of Implementation Method:	Cafeteria AHU, link addition AHU, AHU-S1(library), EF-20, Taxidermy FCU, RTU (natural sciences), AHU-2, AHU-1 (gym), AHU-2(gym) Locker Rm EF (gym AHU-2), EF-1, EF-2, EF-4, EF-21, and Chem Store Rm EF: Review fan statuses trends. Refer to supporting documentation spreadsheet- Calculations- ELY CALCULATIONS-1.		

Annual Electric Savings (kWh):	48,694	Annual Fuel Oil Savings (Gallons):	553
Estimated Annual kWh Savings ($):	$4,772	Estimated Annual Fuel Oil Savings ($):	$1,749
Contractor Cost ($):	$1,000		
PBEEEP Provider Cost for Implementation Assistance ($):	$0		
Total Estimated Implementation Cost ($):	$1,000		

Estimated Annual Total Savings ($):	$6,521	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.15	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.15	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	48	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	16.0%	Percent of Implementation Costs:	0.4%

Findings Details

Building: Vermilion Community College

FWB Number:	16100	Eco Number:	3
Site:	NHED Vermilion Ely	Date/Time Created:	5/31/2012

Investigation Finding:	New Condensing Boiler	Date Identified:	3/1/2012
Description of Finding:	Existing boiler efficiency is estimated at 80% efficient. New condensing boiler with linkageless controls and stack dampers is 90% efficient (Fulton Vantage on oil, min SWT 160F; operates at 90% efficient throught range of operation); thus energy savings of 10%.		
Equipment or System(s):	Boiler Plant	Finding Category:	Retrofits
Finding Type:	Retrofit - Boilers		

Implementer:	Contractor	Benefits:	Increased efficiency
Baseline Documentation Method:	Used existing 3yr average fuel oil usage to idendity baseline and calculated typical efficiency gains with new equipment.		
Measure:	Install new condensing boiler		
Recommendation for Implementation:	Remove existing boilers and heat exchangers and replace with two Fulton 3million BTU boilers; dual fuel (Fuel Oil & LP); 90% efficient throughout operating temperatures; due to fuel oil operation, operate at 160SWT (still at 90% efficient-see cut sheets). Existing boiler is estimated at 80% efficient.		
Evidence of Implementation Method:	Verify installation is complete via photos.		

Annual Fuel Oil Savings (Gallons):	4,914	Contractor Cost ($):	$200,000
Estimated Annual Fuel Oil Savings ($):	$15,534	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$200,000

Estimated Annual Total Savings ($):	$15,534	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	12.88	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	12.88	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	54	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	38.2%	Percent of Implementation Costs:	75.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Vermilion Community College

FWB Number:	16100	Eco Number:	4
Site:	NHED Vermilion Ely	Date/Time Created:	5/31/2012

Investigation Finding:	Boiler Burner Upgrade. This is an alternate to Finding 3.	Date Identified:	3/1/2012
Description of Finding:	Existing boiler turndown of 2.5:1. New boiler burner with linkageless controls and stack dampers is estimated to provide 5% energy savings.		
Equipment or System(s):	Boiler Plant	Finding Category:	Retrofits
Finding Type:	Retrofit - Boilers		

Implementer:	Contractor	Benefits:	Increased efficiency
Baseline Documentation Method:	Used existing 3yr average fuel oil usage to idendity baseline and calculated typical efficiency gains with new equipment.		
Measure:	Install new boiler burner		
Recommendation for Implementation:	Replace Hurst boiler burner with new 6.6million BTU ProFire/IC burner at 85% efficient with stack dampers.		
Evidence of Implementation Method:	Verify installation is complete via photos.		

Annual Fuel Oil Savings (Gallons):	2,602	Contractor Cost ($):	$40,000
Estimated Annual Fuel Oil Savings ($):	$8,224	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$40,000

Estimated Annual Total Savings ($):	$8,224	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.86	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.86	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	29	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	20.2%	Percent of Implementation Costs:	15.1%

Findings Details

Building: Vermilion Community College

FWB Number:	16100	Eco Number:	6
Site:	NHED Vermilion Ely	Date/Time Created:	5/31/2012

Investigation Finding:	OA Reduction	Date Identified:	3/1/2012
Description of Finding:	AHU-1 (GYM) found to have excessive OA intake via T&B & OA calculation comparison.		
Equipment or System(s):	AHU with heating only	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	AHU-1 (GYM) found to have excessive OA intake via T&B & OA calculation comparison.		
Measure:	Revise OA balance match ASHRAE 62 calculations: 4000cfm to 2900 cfm.		
Recommendation for Implementation:	Revise OA balance match ASHRAE 62 calculations: 4000cfm to 2900 cfm.		
Evidence of Implementation Method:	Review test and balance report and verify MAT's & airflows		

Annual Fuel Oil Savings (Gallons):	671	Contractor Cost ($):	$1,000
Estimated Annual Fuel Oil Savings ($):	$2,120	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$1,000

Estimated Annual Total Savings ($):	$2,120	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.47	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.47	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	7	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	5.2%	Percent of Implementation Costs:	0.4%

Findings Details

Building: Vermilion Community College

FWB Number:	16100	Eco Number:	7
Site:	NHED Vermilion Ely	Date/Time Created:	5/31/2012

Investigation Finding:	DAT Reset	Date Identified:	3/1/2012
Description of Finding:	AHU-1 (Theature), AHU-2 (Museum), AHU-3 (Classroom unit): MAT is always maintained at its low limit setpoint of 50 degF because the OA flow station is out of calibration (never reaches min flow setpoint). DAT is maintaining setpoint of 55 degF. Unit is over-ventilating and the VAV reheats are providing most of the heat for the space. Reseting the DAT setpoint to 65 at cooler outside air temperatures and calibrating the OA flow station would eliminate the need to heat excess ventilation air.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Air Temperature Reset is not implemented or is sub-optimal		

Implementer:	Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	AHU-1 (Theature) & AHU-2 (Museum)-Current Operation: MAT is always maintained at its low limit setpoint of 50 degF because the OA flow station is out of calibration (never reaches min flow setpoint). DAT is maintaining setpoint of 55 degF. Unit is over-ventilating and the VAV reheats are providing most of the heat for the space. Proposed Operation: Reset AHU DAT from 55 to 65 degF with OAT from 55 to 45 degF. Assume the same reheat DAT as baseline. Calibrate OA flow station and maintain a new min OA flow requirement of 1130 cfm/950 cfm, which is the code minimum. Savings are from decreased VAV reheating load and reduced ventilation air. AHU-3 (Classroom unit)-Current Operation: During the initial site visit, unit was maintaining MAT at its low limit setpoint of 50 degF and DAT was maintaining setpoint of 55 degF. Adjustments have since been made to the unit from our initial site trip (screen captures) to when the trends were available to download. From the trends, the DAT setpoint has been increased to 68/70 degF. Calculations based on trended averages. Proposed Operation: Reset DAT from 55 to 65 degF with OAT from 55 to 45 degF. Assume the same reheat DAT. Calibrate OA flow station and maintain min OA flow requirement. Retain existing MAT low limit setpoint, so that OA damper will modulate to maintain MAT of 50 degF at low OAT. Savings from decreased AHU heating load.		
Measure:	Implement DAT reset schedule for each AHU. Calibrate/repair Outside airflow measuring stations. Set outside airflow minimum setpoints.		
Recommendation for Implementation:	Implement DAT reset schedule for each AHU. Calibrate/repair Outside airflow measuring stations. Set outside airflow minimum setpoints.		
Evidence of Implementation Method:	Review trend data; MAT, DAT, OA Flow, damper positions		

Annual Fuel Oil Savings (Gallons):	2,047	Contractor Cost ($):	$5,000
Estimated Annual Fuel Oil Savings ($):	$6,470	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$5,000

Estimated Annual Total Savings ($):	$6,470	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.77	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.77	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	23	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	15.9%	Percent of Implementation Costs:	1.9%

Deleted Findings Summary

Building: Vermilion Community College
Site: NHED Vermilion Ely

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
5	Additional BAS Controls	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Vermilion Community College

FWB Number:	16100	Eco Number:	5
Site:	NHED Vermilion Ely	Date/Time Created:	6/5/2012

Investigation Finding:	Additional BAS Controls	Date Identified:	3/1/2012
Description of Finding:	Provide BAS controls for: AHU-1 GYM & AHU-2 Locker RM (SF, OA damper, RA damper, heating valve, heating pump, radiation pump, alarms, schedule, graphics). EF (Locker RM): EF status, alarms. AHU-1 &2 (Cafeteria & Admin Offices): SF's, OA damper, RA dampers, relief dampers, heating valves, heating pumps, alarms, schedules, graphics. RTU (Natural Sciences): Replace Barber-Colman system; SF, EF, CC, HC, OA damper, RA damper, MA damper, status, Airflow measuring station, alarms, graphics.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor	Benefits:	Increased efficiency,less maintenance.
Baseline Documentation Method:	Provide BAS controls for: AHU-1 GYM & AHU-2 Locker RM (SF, OA damper, RA damper, heating valve, heating pump, radiation pump, alarms, schedule, graphics). EF (Locker RM): EF status, alarms. AHU-1 &2 (Cafeteria & Admin Offices): SF's, OA damper, RA dampers, relief dampers, heating valves, heating pumps, alarms, schedules, graphics. RTU (Natural Sciences): Replace Barber-Colman system; SF, EF, CC, HC, OA damper, RA damper, MA damper, status, Airflow measuring station, alarms, graphics. Typical constrol savings of 10% of equipment operation costs		
Measure:	Install new BAS system at a cost of $15,000		
Recommendation for Implementation:	Provide BAS controls for: AHU-1 GYM & AHU-2 Locker RM (SF, OA damper, RA damper, heating valve, heating pump, radiation pump, alarms, schedule, graphics). EF (Locker RM): EF status, alarms. AHU-1 &2 (Cafeteria & Admin Offices): SF's, OA damper, RA dampers, relief dampers, heating valves, heating pumps, alarms, schedules, graphics. RTU (Natural Sciences): Replace Barber-Colman system; SF, EF, CC, HC, OA damper, RA damper, MA damper, status, Airflow measuring station, alarms, graphics.		
Evidence of Implementation Method:	Verify equipment via photos, review BAS graphics		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR VERMILION COMMUNITY COLLEGE

Admin Minnesota
DEPARTMENT OF ADMINISTRATION

August 29, 2011

Summary Table

Vermillion Community College	
Location	1900 E Camp St Ely, MN 55731
Facility Manager	Dave Marshall
Number of Buildings	14
Interior Square Footage	180,376
PBEEEP Provider	Center for Energy and Environment (Gustav Brandstrom)
Date Visited	January 22, 2011
Annual Energy Cost (from B3)	$293,750 (2010)
Utility Company	Range Cooperatives (Propane) Ely Water & Light(Electricity) Various (Fuel Oil)
Site Energy Use Index (from B3)	81 kBtu/sq ft (2010)
Benchmark EUI (from B3)	111 kBtu/sq ft

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of Vermillion Community College was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on January 22, 2011 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

The Vermillion Community College campus consists of 14 buildings with a total of 180,376 square feet (sq ft) located in Ely, MN. Most buildings are college classrooms.

Recommendation for Investigation

Vermillion Community College's has large area, large HVAC equipment, and high level of automation. The campus has expensive fuel oil for heating fuel. Therefore, CEE recommends the full investigation of selected buildings at Vermillion CC.

Building Name	State ID	Square Footage	Year Built
Activities "A" Bldg	E26147C0171	22,690	1971
Administration/College Services	E26147C0271	20,578	1971
Classroom "D" Bldg	E26147C0371	17,886	1971
College Center "C" Bldg	E26147C0785	16,608	1985
Link Bldg/Cafeteria Expansion/Boiler	E26147C1199	13,286	1999
Museum/Interpretive Center	E26147C0580	1,536	1980
Natural Science Building	E26147C0893	9,832	1993
Phy Ed/Enrollment Wing	E26147C1285	2,500	1985
Theater/Fine Arts	E26147C0480	15,697	1980
Maintenance Garage	E26147C0993	1,856	1993
Wood Boiler Plant	E26147C0685	1,611	1985
Modular Classroom ITV	E26147C1095	1,680	1995
Modular Housing Units	E26147C5193	18,480	1993
Vermilion Residence Hall	E26147C5087	36,136	1987
		180,376	

Building Overview Section

Mechanical Equipment

Heating Plant

The heat at Vermillion comes from two fuel oil boilers and one wood burning boiler (it has not been used lately because of the cost of wood and gas). The hot water is pumped around the campus using three variable speed 3hp, 85 GPM pumps to all buildings on campus.

Cooling Plant

About three quarters of the campus is cooled, but all cooling is done by unitary DX systems. There is no central cooling plant.

Buildings

Most buildings are conditioned by AHUs with DX cooling and hot water heat. There is a fairly even split between constant volume and variable volume AHUs. All VAV boxes have reheat coils and DDC controls.

Controls and Trending

The entire campus is using a Honeywell EBI building automation system. The Honeywell computer is located in the Maintenance Building and can accept USB flash drives for data extractions. The Honeywell system can trend up to 2,000 points and does it very well.

Lighting

Indoor lighting- Interior lighting primarily consists of T8, T5, and LED, therefore a lighting retrofit will not need to be investigated. Most classroom lights are operated by a manual switches.

Outdoor lighting- The outdoor lighting consists of parking lot lighting, side walk lights and some decorative lighting. Some of the lighting is on the BAS and is operated using schedules and daylight sensors.

Energy Use Index B3 Benchmark

The site Energy Use Index (EUI) for the building is 81.2 kBtu/sq ft, which is 27% lower than the B3 Benchmark of 111 kBtu/sq ft. The occupancy in the summer is very low and might be the cause of the low EUI. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average. This shows that Vermillion CC might be performing about average in the state.

Metering

The campus has two electrical meters, one fuel oil meter for campus heating, and four propane meters. The entire campus except for the modular housing unit is on one electrical meter. The fuel oil is used only for the large hot water boilers. The propane meters are for spot uses, the dining hall, locker rooms, modular housing, and the maintenance building.

Documentation

The campus blueprints are all collected in the Maintenance office. There have been several upgrades in the last ten years and plans are available for most of them. There are also balancing report for some of the upgrades.

Occupancy
The class schedule is from 8am to 4pm in general, but there are some night classes that end at 10pm Monday through Saturday. The only building open on Sundays is the library. The HVAC runs 5am to 11pm. During the summer the buildings are open Monday through Friday 8am to 5pm.

Central Plant
State ID# E26147

Area (sq ft)		Year Built		EUI/Benchmark	

HVAC Equipment

Boilers (Total)

Description	**Type**	**Size**	**Notes**
BLR-1	Fuel Oil Boiler	5.6 million Btu/h	
BLR-2	Fuel Oil Boiler		
BLR-3	Wood Fired Boiler		Not used because the cost of wood.

Heating Pumps (Total)

Description	**Type**	**Size**	**Notes**
HWP-L1	Variable Speed Pump	3hp, 85GPM	
HWP-L2	Variable Speed Pump	3hp, 85GPM	
HWP-L3	Variable Speed Pump	3hp, 85GPM	

Points on BAS

Hot Water System

Description	**Points**
North Boiler Room	CP-1 & 2 & 3 Status, WB3-HWST, WB3-HWRT, WB4-HWST, WB4-HWRT, WB3 Valve Pos, WB4 Valve Pos, OAT
Converter and Pump Control	HWST and Setpoint, HWRT, Pumps L-1, L-2, and L-3 Status, CP-1, CP-2, CP-3
Boiler Room	HWST and Setpoint, HWRT and Setpoint, HWP L-1 Status and Speed, HWP L-2 Status and Speed, HWP L-3 Status and Speed, HX1 Valve Pos, HX2 Valve Pos, HX3 Valve Pos, CP-4 Status, CP-5 Status, WB2 Valve Pos, WB-2 HWST and HWRT

Theatre/Fine Arts State ID# E26147C0480			
Area (sqft)	15697	Year Built	1971
HVAC Equipment			

Air Handlers (7 Total)

Description	**Type**	**Size**	**Notes**
AHU 1	VAV AHU	SF 9,495 cfm, 10hp, RF 7,940 cfm,5hp	Has 105lb/h humidifier. DX Cooling.
AHU 2	VAV AHU	SF 6,885 cfm, 10 hp, RF 6,200 cfm,5 hp	Has 71lb/h humidifier. DX Cooling.
AHU 3	VAV AHU	SF 13,840 cfm, 20hp EF 11,125 cfm, 3hp (EF20)	Serves Theatre.

VAV Boxes (34 Total)

Description	**Type**	**Size**	**Notes**
34 VAVs	VAVs (Trane)	100-3,310 Max cfm	All have reheats

ERV (x Total)

Description	**Type**	**Size**	**Notes**
ERV1	ERV	SF: 1,710 cfm,1.5 hp, EF: 1,555 cfm,1.5 hp	Supplies AHU1 with fresh air.

Hot Water Pumps (5 Total)

Description	**Type**	**Size**	**Notes**
P1	Pump	110 gpm,2hp	Theatre/Museum HWS
P2	Pump	110 gpm, 2hp	Theatre/Museum HWS
P3	Pump	80 gpm, 3hp	Classroom HWS
P4	Pump	80 gpm, 3 hp	Classroom HWS
P5	Pump	7.5 gpm, 1/12 hp	HW Recirc

Exhaust Fans (x Total)

Description	**Type**	**Size**	**Notes**
EF 4	Exhaust Fan	660 cfm, 0.25 hp	Classroom toilets
EF 7	Exhaust Fan	1200 cfm, 0.25 hp	Art Hood
EF 9	Exhaust Fan	340 cfm, 0.13 hp	Kiln
EF 11	Exhaust Fan	650 cfm, 0.13 hp	Mech Room
EF 21	Exhaust Fan	570 cfm, 0.125 hp	FA110-FA 109
EF 22	Exhaust Fan	80 cfm, 0.125 hp	FA108
EF 23	Exhaust Fan	80 cfm, 0.125 hp	FA104A
EF 24	Exhaust Fan	80 cfm, 0.125 hp	FA104B

Points on BAS

Air Handlers

Description	Points
AHU 3	Econ Damper, Space Static Pressure and Setpoint, HWP 13 Status, MA Damper Pos, MinOA Damper Pos, RAT, RAT DX Setpoint, MAT, DSP and Setpoint, DAT and Setpoint, OA Flow and Setpoint, Heating Valve, SF-S and Speed, EF-S and Speed

Exhaust Fans

Description	Points
Exhaust Fan EF4	EA Fan Sts, EA Fan S/S

Hot Water System

Description	Points
Theatre	HW Ret Temp, HW Flow Sig, System En OAT Sp, Diff Press Sp, Min of Two Diff. Press, Diff Press1, DiffPress2,HWP1 Spd,HWP1 Run Hrs, HW Sup Temp, Pmp Rotation Run Hrs Sp, HWP2 Spd, HWP2 Run Hrs,
Classroom	HW Ret Temp, System En OA Temp Sp, Diff Press Sp, Diff Press, HW Flow Sig, HWP3 Spd, HWP3 Run Hrs, HW Sup Temp, Pmp Rotation Run Hrs Sp, HWP4 Spd, HWP4 Run hrs,

Library, Admin State ID# E26147C0271					
Area (sq ft)	15697	Year Built	1971		
HVAC Equipment					

Air Handlers (Total)

Description	Type	Size	Notes
AHU1	VAV AHU	SF: 10,500 cfm, 15 hp EF1: 1,000cfm, 5hp	Has 30 ton DX Cooling.

Exhaust Fans (x Total)

Description	Type	Size	Notes
EF 2	Bath	250 cfm, 0.16 hp	
EF 3	Bath	550cfm, 0.16 hp	

VAV (x Total)

Description	Type	Size	Notes
VAV 101	VAV	1,200 cfm	101D,E,F,105c,d,e,109,110
VAV 102	VAV	670 cfm	105a,b
VAV 103	VAV	445 cfm	103,a,104a,105
VAV 104	VAV	660 cfm	101,101b,101c
VAV 105	VAV	965 cfm	108,108a,110,111
VAV 106	VAV	445 cfm	104,104a
VAV 107	VAV	190 cfm	102a
VAV 108	VAV	850 cfm	Corridor
VAV 109	VAV	645 cfm	106,106a,106b,106c,106d,Corridor
VAV 110	VAV	1,020 cfm	107
VAV 111	VAV	350 cfm	102b,102c
VAV 112	VAV	1,060 cfm	Library
VAV 113	VAV	1,060 cfm	Library
VAV 114	VAV	1,060 cfm	Library

Points on BAS

Air Handlers

Description	Points
AHU S-1	Library Rm Static Sp, Library Room Static, RAT, RA C02, Dx En OA Sp, Dx , Dx Stages, Dx Stages 1-3, MAT Sp, MAT LL Sp, MAT, EA Fan DP Sts, EA Fan Spd, EA Fan DP Sts, MA Damper, SAT, SAT Sp, SA Hi Press, OA Min CFM Sp, Htg Vlv, HW Pump En OA Sp, Clg SAT, SA Fan Spd,OA CFM, HW Pump En OA Sp, HW Pump Alm, SA Fan Spd, SA Fan DP Sts, SA Fan VFD Alm, Static Press Sp, Static Press

Convection Units

Description	Points
Units 1-3	Rad Vlv, Room Temp, Room Temp ActSp, Room Temp SP Overide, HWS, HWR

Exhaust Fans

Description	Points
EF 1	(CUH) Room Temp, Room Temp Sp, Eff Room Temp Sp
EF2	(CUH) Room Temp, Room Temp Sp, Eff Room Temp Sp

Coil Units

Description	Points
RHC 2,3,4,5,6,7	Reheat Vlv Pos, Hyd Status mode, Room Temp, Room temp Sp, Room Temp Sp Override

“C” Campus Center State ID# E26147C0785					
Area (sq ft)	16608	Year Built	1985		
HVAC Equipment					

Air Handlers (7 Total)

Description	Type	Size	Notes
AHU 1	AHU	2hp,2,600 cfm,107 MBH	Addition
AHU 2	VAV AHU	7.5 hp,7,500 cfm,240 MBH	Link Addition
EAHU 1	AHU	240 MBH Heat	Cafeteria
AHU	AHU	3,600 cfm,5hp	Mech Room
AHU	AHU	12,352 cfm,15 hp	Mech Room

VAV Boxes (7 Total) (ALL HAVE REHEAT)

Description	Type	Size	Notes
VAV1	VAV	3,000cfm	
VAV2	VAV	700 cfm	
VAV3	VAV	400 cfm	
VAV4	VAV	1,600 cfm	
VAV5	VAV	1,400 cfm	
VAV6	VAV	500 cfm	
VAV7	VAV	850 cfm	

HW Heat Exchanger (3 total)

Description	Type	Size	Notes
HX1	Exchanger	3,076 MBH,94 cfm, 246 gpm	Shell and Coil.
HX2	Exchanger	3,076 MBH,94 cfm, 246 gpm	Shell and Coil.
HX3	Exchanger	3,076 MBH,94 cfm, 246 gpm	Shell and Coil.

UH (10 total)

Description	Type	Size	Notes
UH 1	Unit Heater	Frac HP	
UH 2	Unit Heater	Frac HP	
UH 3	Unit Heater	Frac HP	
HW UH	Unit Heater	105 MBH,543 cfm, 1/20 hp	
HWUH	Unit Heater	15.85 MBH,543 cfm, 1/20 hp	
HWUH	Unit Heater	18.8 MBH, 543 cfm, 1/20 hp	
HWUH	Unit Heater	18.4 MBH, 543 cfm, 1/20 hp	
HWUH	Unit Heater	11.2 MBH, 1/20 hp	
HWUH	Unit Heater	12.5 MBH, 1/20 hp	
HWUH	Unit Heater	10.4 MBH, 1/25 hp	

Cabinet Heater

Description	Type	Size	Notes
HW Cab Htr	Cab Htr	20.2 MBH, 1/30 hp	
HW Cab Htr	Cab Htr	19.2 MBH, 1/30 hp	
HW Cab Htr	Cab Htr	24.5 MBH, 1/30 hp	
HW Cab Htr	Cab Htr	15.0 MBH, 1/60 hp	
HW Cab Htr	Cab Htr	9.6 MBH, 1/60 hp	

HVAC Equipment Cont'd

Exhaust Fans (x Total)

Description	Type	Size	Notes
EF	Exhaust Fan	1/6 hp	Dishwasher hood
EF 1	Exhaust Fan	273W, 600 cfm	
EF 2	Exhaust Fan	1/6 hp, 300cfm	
EF 3	Exhaust Fan	1 hp, 2,750 cfm	
EF 4	Exhaust Fan	¾ hp, 6,970 cfm	
RAF	Return Air Fan	5hp, 12,352 cfm	Mech Room
RAF	Return Air Fan	1 hp, 4,024 cfm	
EF	Exhaust Fan	190W, 240 cfm	
EF	Upblast Exhaust Fan	1hp, 1,200 cfm	
EF	Exh Fan	224W, 384 cfm	
EF	Exh	290W, 600 cfm	
EF	Upblast Exh	¾ hp, 1,800 cfm	
EF	Upblast Exh	½ hp, 1,600 cfm	
EF	Upblast	1.5hp, 5,500 cfm	
EF	Exh Fan	190W, 200cfm	
EF	Exh Fan	190W, 280 cfm	

Hot Water Coil Pumps (10 Total)

Description	Type	Size	Notes
CP 1	Circ Pump	¾ hp	
CP 2	Circ Pump	¾ hp	
CP 3	Circ Pump	¾ hp	
CP 4	Circ Pump	¾ hp	
CP 5	Circ Pump	¾ hp	
CP 6	Circ Pump	½ hp	
CP 7	Circ Pump	½ hp	
CP 8	Circ Pump	¾ hp	
CP 9	Circ Pump	¾ hp	
S1	Stand By Pump	10 hp	
CP1	Boiler Circ	185 cfm, 3hp	
CP2	Boiler Circ	185 cfm, 3 hp	
CP3	Boiler Circ	185 cfm, 3hp	
CP4	Boiler Circ	125 cfm, ¾ hp	
CP5	Boiler Circ	125 cfm, ¾ hp	
CP6	Boiler Circ	32 cfm, ½ hp	
CP7	Boiler Circ	32 cfm, ½ hp	
CP8	Boiler Circ	28 cfm, ¼ hp	
CP9	Boiler Circ	18 cfm, ¾ hp	
Heat Pump	Pump	150.2 gpm, 5 hp	
Heat pump	Pump	14.50 gpm, ½ hp	

Points on BAS

Air Handlers

Description	Points
Link Addition AHU	RAT,RA Flow, MA Damper, Filter Sts, Dx Stage, SAT Sp, SAT, OA Flow, OA Flow Sp, MAT, Htg Vlv, SA Fan VFD , SF Fan VFD, Static Press, Static Press Sp, Cooling Disable Sp, Econ Setpoint, Htg Vlv Disable, Mix Lo Lim Temp, OA Flow Stpt, Sup Air Fan, Sup Air Fan Vol Ctrl, Static Press Setpoint, SAT Setpoint, System Start
Cafeteria	RAT, Smk Det, Space temp, Space Temp Sp, Occ Mode, MA Dmprs, Filter Sts, Dx Stage, Freeze Alm, SAT, MAT, Htg Vlv, SA Fan S/S, Cafeteria Setpoints: Cooling Dis Stpoint, Cooling Signal, Sup Air Filter Alrm, SAT, Damper Min Pos, DX Stage, Econo Signal, Freeze Alrm, Htg Sig, Htg Vlv, Htg Vlv Dis, Mix Air Damper, MAT, Mix Lo Lim Temp, Return Air Smoke Det, RAT, Room Temp, Sup Air Fan, Sup Air Fan Status, Space Temp Setpoint, Sup Ramp Sig, System Start

VAV Boxes

Description	Points
VAV	Dmprs Pos, Reheat Vlv, Air flow, Air flow Sp, Room Temp, Room Temp Sp, Manual Sp

Converters/Pump Control

Description	Points
Converter/ Pump Control	Bldg Water Sup Temp, Bldg Water Sup Temp Sp, Bldg Sup Pump , L1 Status, L2 Status, L3 Status, CP1 Alm, CP2 Alm, CP3 Alm, number of pumps selector

Boiler Room Temperature Control

Description	Points
North Boiler	OAT,WB 3lso Vlv,WB 3 Ret Temp, WB3 Parameter/Alm, WB3 Sup Temp, WB4 Ret Temp, WB4 Sup Temp, Blr Cp1 S/S, blr CP S/S, Blr CP3 S/S,WB4 lso Vlv, WB4 S/S, WB 4 Alm
Existing Blr	Hx Vlv, Pmd Spd Tmp Sp, HW Ret Temp, HWP L1 S/S , HWP1 Speed, HWP L1 Alm, HWP L3 S/S, HWP L3 Speed, HWP L3 Alm, HWP L2 S/S, HWP L2 Speed, HWP L2 Alm, HW Sup Temp, Sup Temp Sp, Hx Vlv, Hx Vlv2, CP4 S/S, CP 5 S/S, WB2 lso Vlv, WB2 Sup Temp, WB2 Ret Temp, WB2 S/S, WB Alm

Natural Science State ID# E26147C0893					
Area (sqft)	9832	Year Built	1993		
HVAC Equipment					

Air Handlers (7 Total)

Description	Type	Size	Notes
AHU 1	EQ1	2490 cfm, 1.5 hp	

Exhaust Fans (x Total)

Description	Type	Size	Notes
EF	EQ 3 (Exh Fan)	1050 cfm, ¼ hp	
EF	EQ 4 (Existing)	888 cfm, 1/3 hp	
EF	EQ 6 (Exh Fan)	600 cfm, 1/6 hp	
Fan	AHU1	16475 cfm, 20hp	

Pumps (x Total)

Description	Type	Size	Notes
P1	Pump	50 gpm, 0.75 hp	

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HUH	Horizontal Unit Heater
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temp	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CUH	Cabinet Unit Heater	MAT	Mixed Air Temperature
CV	Constant Volume	MAU	Make-up Air Unit
DA	Discharge Air	OA	Outside Air
DA Enth	Discharge Air Enthalpy	OA Enth	Outside Air Enthalpy
DARH	Discharge Air Relative Humidity	OARH	Outside Air Relative Humidity
DAT	Discharge Air Temperature	OAT	Outside Air Temperature
DDC	Direct Digital Control	Occ	Occupied
DP	Differential Pressure	PTAC	Packaged Terminal Air Conditioner
DSP	Duct Static Pressure	RA	Return Air
DX	Direct Expansion	RA Enth	Return Air Enthalpy
EA	Exhaust Air	RARH	Return Air Relative Humidity
EAT	Exhaust Air Temperature	RAT	Return Air Temperature
Econ	Economizer	RF	Return Fan
EF	Exhaust Fan	RH	Relative Humidity
Enth	Enthalpy	RTU	Rooftop Unit
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FPVAV	Fan Powered VAV	UH	Unit Heater
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes
HP	Horsepower	VUH	Vertical Unit Heater

Conversions:
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH